Green Foundry Project 2002-02

Carbon Capture and Conversion to Biomass by Fast-Growing Cyanobacteria Cultivated on Wastewater

☐ Full Scale Implementation OR ☒ Pilot Scale/Study

1. Description of the project: What is the issue and how did you fix it?

The control of carbon emissions (primarily carbon dioxide - CO2) poses a future challenge for metalcasting and other industries in support of potential environmental, societal, and regulatory pressures which may have a negative future impact on the energy intensive process of melting iron for reuse. Beyond energy efficiency improvements, there have been limited tools available to effect additional reductions in carbon-based emissions. While not currently recognized as technically or economically feasible, carbon sequestration technologies have been researched as a potential means to capture CO2 to generate value added byproducts for use as a feedstock in other industries. With project partners Algoma Algal Biotechnology (AABT) and community stakeholders, a trial was designed and implemented to grow fast-growing algae (cyanobacteria or eukaryotic algae, some of which can double their mass in less than 2 hours) on exhaust emissions occurring from a cupola melting unit. The trial utilized CO2 resulting from cupola operations and the local city's wastewater as a growth medium, with a standard commercial CO2 supply and lab grade growth medium as controls. Due to the timing of the trial in Wisconsin's wintermonths, an artificial light source from LEDs was utilized in lieu of sunlight.

The trial (conducted within 8-Liter air lift photobioreactor tubes) resulted in findings that:

- All species of algae utilized flourished in the cupola CO2 source, with no reduction of growth as compared to the CO2 control source.

- The nutrients from the wastewater growth medium was the primary limiting factor as compared to the control medium. (Wastewater medium is preferred as it is a potentially economical source of nutrients and provides wastewater treatment benefits to the local publicly owned treatment works.)

- The Phase 1 pilot test resulted in sufficiently favorable growth results to support the consideration of a larger Phase 2 trial to generate greater amounts of biomass for introduction to processes to convert the algal biomass into a biocoal, bio-coke or other marketable co- product.

2. Environmental Benefits: Conservation of raw materials or energy, reduction or elimination of emissions, wastes, toxics, water discharges, etc.

While the Phase 1 trial did not include a demonstration of economic feasibility, it provided initial data suggesting the technical feasibility of the conversion of cupola melting unit carbon emissions to algal biomass, reducing stack emissions and generating a feedstock with potential return back to the foundry operation.

3. Other Benefits: Productivity, health and safety, employee morale, etc.

This project has generated a tremendous amount of local stakeholder interest, with facility neighbors and city officials collaborating to achieve a completed Phase 1 trial.

4. Cost Savings: Capital cost, operating cost, ROI or other pertinent cost information.

Data regarding economic feasibility will be investigated in the Phase 2 trial.

5. Applicability to other foundries and additional Comments

If viable, the algal process for carbon recycling to biomass/energy can be utilized by any industry with carbon emissions.

6. Applicable Environmental Categories and Foundry Processes. Select all that apply.

Environmental Categories

☒ Carbon (GHG) Emissions Measurement and Reduction

☐ Air Quality ☐ Water Use and Discharge ☐ Waste Management

☐ Beneficial Use ☐ Stormwater ☒ Material and Resource Conservation

☒ Community Engagement

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Foundry Process(es) Impacted

☒ Melt ☐ Pour ☐ Mold ☐ Core ☐ sand system/reclaim

☐ Shakeout ☐ Heat Treat ☐ Quench ☐ Finishing ☐Shipping

☐ Maintenance ☐ Pattern Shop ☐ Casting Design

☐ Management Systems and Metrics

☐ Other, explain: Click or tap here to enter text.

7. Add photos to enhance your application, if applicable.